

**NATURAL RESOURCES CONSERVATION SERVICE
CONSERVATION PRACTICE STANDARD**

WINDBREAK/SHELTERBELT ESTABLISHMENT

(Feet)

Code 380

DEFINITION

Linear plantings of single or multiple rows of trees or shrubs or sets of linear plantings.

PURPOSES

- To reduce soil erosion from wind
- To protect plants from wind related damage
- To alter the microenvironment for enhancing plant growth
- To manage snow deposition
- To provide shelter for structures, livestock, and recreational areas
- To enhance wildlife habitat by providing travel corridors
- To provide living noise screens
- To provide living visual screens
- To provide living barriers against airborne chemical drift
- To delineate property and field boundaries
- To improve irrigation efficiency
- To enhance aesthetics
- To increase carbon storage

CONDITIONS WHERE PRACTICE APPLIES

On any areas where linear plantings of woody plants are desired and suited.

CRITERIA

General Criteria Applicable To All Purposes

The location, layout and density of the planting will accomplish the purpose and function intended within a 20-year period.

The maximum design height (H) for the windbreak or shelterbelt shall be the expected height of the tallest row of trees or shrubs at age 20 for the given site. See TREE/SHRUB SUITABILITY GROUPS, IL-FOTG Section II, Windbreak Interpretations.

The distance that protection extends from the windbreak's leeward side is proportional to its height. The most effective zone of protection extends to a distance 2 to 5 times (2H - 5H) its height, while significant protection extends to 10H.

Species must be adapted to the soils, climate and site conditions, see TREE/SHRUB SUITABILITY GROUPS, IL-FOTG, Section II, Windbreak Interpretations. Changes in soil properties within the planting site may require the species to change within the row or selection of species with a wide range of adaptability.

Species shall be suited for the planned practice purpose(s).

Multiple species, within rows, may be used if heights, growth rates and growth forms are similar.

Site preparation shall be sufficient for establishment and growth of selected species, not contribute to erosion, and be appropriate for the site, see practice standard 490, FOREST SITE PREPARATION.

Only viable, high quality, and adapted planting stock or seed will be used.

The planting shall be done at a time and manner to insure survival and growth of selected species.

Spacing between individual plants shall be based on the needed growing space for plant type and species, the accommodation of maintenance equipment, and the desired characteristics of the stem(s), branches and canopy as required for a specific purpose.

For optimal carbon storage, select plants that are adapted to the site to assure strong health and vigor and plant the full stocking rate for the site.

Trees and/or shrubs will not be planted where they will interfere with structures and/or above or below ground utilities. Woody plants will be established without compromising the integrity of property lines, fences, utilities, roads, legal drains, easements or rights of way.

Allow at least an 16-foot maintenance strip from the outside row of trees or shrubs to adjacent property lines or contrasting land use areas.

Comply with applicable federal, state and local laws and regulations during the installation, operation, and maintenance of this practice. Appropriate cultural resources review will be conducted before beginning any tree planting practice.

Where subsurface drains (tile lines) cross a tree/shrub planting, and where these drains will remain functional, sealed conduit will be installed through the planting and extend a minimum of 100 feet from rows of large trees (capable of reaching heights greater than 60 feet) and 75 feet from all other trees and shrubs. Trees and shrubs will not be planted within 50 feet of either side of subsurface drains.

When placing an opening through a windbreak, make the opening on an angle to reduce the loss of wind protection. Whenever possible locate access roads at the ends of windbreaks, beyond the area where snowdrifts form.

Trees and/or shrubs that will be planted near paved roads subject to application of de-icing salt will be salt tolerant. See "[Right Tree – Right Place](#)" in listed REFERENCES for a list of salt tolerant trees and shrubs.

All windbreaks will have sufficient setback from roadways, rights of way, and structures to prevent drifting snow from blocking traffic. Factors affecting the size and location of snowdrifts include potential snow accumulation, direction of potential winter winds, proximity of windbreak to traffic area, and the density of the windbreak.

Additional Criteria To Reduce Wind Erosion and To Protect Plants from Wind Related Damage

The windbreak will be oriented as close to perpendicular to troublesome winds as possible.

Temporary measures will be installed to supplement the windbreak until it is fully functional.

Sites, fields, and plants are protected within an area 10 times the design height (H) on the leeward side and two times the design height (H) on the windward side of the windbreak.

The interval between windbreaks shall be determined using current, approved, wind erosion technology. Interval widths shall not exceed that permitted by the soil loss tolerance (T), or other planned soil loss objective. Calculations shall account for the effects of other practices in the conservation management system.

Base spacing between sets of windbreaks on the level of plant protection desired. Some crops and their annual/acre tolerance to windblown soil are listed below.

- Tolerant (3 tons): barley, oats, rye, wheat
- Moderate tolerance (2 tons): corn, grain sorghum, sunflowers
- Low tolerance (1 ton): apples, cherries, peaches
- Very low tolerance (< 1 ton): alfalfa, cotton, vegetables, potatoes

Additional Criteria To Manage Snow Deposition

The windbreak will be oriented as close to perpendicular to the snow-bearing wind as possible.

For snow distribution across a field, the windbreak density (during expected snow-producing months) shall not be less than 25 percent nor greater than 50 percent. (See Density under Plans and Specifications) The interval between barriers will not exceed 20H.

For snow accumulation, the minimum barrier density, during expected snow-producing months, will be 50 percent.

The windward row will be at least 80 feet (60 feet south of Interstate 64) from the area to be protected. The windward row will be no more than 250 feet from the area to be protected.

Windbreaks will be located so that snow deposition will not pose a health or safety problem or obstruct human, livestock, or vehicular traffic.

Where water erosion and/or runoff from melting snow is a hazard, it shall be controlled by supporting practices.

To reduce the potential for snow damage in windbreaks use the widest spacing, locate a shrub row windward 40-75 feet from the primary windbreak, and/or locate a shrub row on the leeward side.

Additional Criteria To Provide Shelter For Structures, Livestock, and Recreational Areas

The planting will be oriented as close to perpendicular to the troublesome wind as possible. The distance from the windward row to the area to be protected will be between 80 and 250 feet.

The minimum barrier density will be 65 percent during the months of most troublesome wind and the area to be protected will fall within a leeward distance of no more than 10H. (See Density under Plans and Specifications.)

Drainage of snowmelt from the windbreak shall not flow into the livestock area.

Additional Criteria For Providing or Enhancing Wildlife Habitat or Travel Corridors.

Select plant species that will benefit targeted wildlife species. Refer to practice standard HEDGEROW (422) for a list of recommended woody species for wildlife.

Design dimensions of the planting shall be adequate for targeted wildlife species. Minimum width is 30 feet. For additional information on corridor design see Conservation Corridor Planning in REFERENCES.

Add rows to a planting to increase wildlife benefits. A minimum of one evergreen and one shrub row should be included among the additional windbreak rows. Shrub rows should be located on outside rows. Optimum wildlife usage occurs with 10 or more rows.

Use plants of different sizes, growth forms, food-bearing capabilities and densities to increase diversity.

The windbreak layout shall include a partial east-west orientation, if possible.

During the winter months, direct sunlight is available on southern rows throughout the day. The opportunity to "sun" in a protected southern exposure decreases food needs for wildlife.

Additional Criteria For Noise Screens

Noise screens will be at least 65 percent dense during all times of the year. (See Density under Plans and Specifications.) At least one row will be composed of the tallest-growing species adapted to the site. Establish the noise screen as close to the noise source as practicable.

The length of the noise screen will be twice as long as the distance from the noise source to the receiver.

For high-speed (> 50 mph) traffic noise, the barrier will not be less than 65 feet wide. The leading edge of the planting will be 80-150 feet from the edge of the roadway. The tallest tree row will be capable of attaining a mature height of at least 45 feet.

For moderate speed (< 50 mph) traffic noise, the barrier width shall not be less than 20 feet wide. The leading edge of the planting will be 50-80

feet from the edge of the roadway. The tallest tree row will be capable of attaining a mature height of at least 30 feet.

Species selected will be tolerant to noxious emissions, sand, gravel and salt spray depositions from traffic areas.

Additional Criteria For Visual Screens

Visual screens shall be located as close to the observer as possible with a density, height and width to sufficiently block the view at all times of the year.

Additional Criteria To Provide Barriers Against Airborne Chemical Drift

Windbreaks that are planted to control chemical drift function by both reducing wind speed to limit drift and by absorbing spray drift on plant parts. Use at least one row of the tallest adapted species to maximize the effectiveness of the windbreak.

Additional Criteria For Improving Irrigation Efficiency

For sprinkler irrigation systems, the windbreak shall be as tall as the sprinkler heads.

The barrier shall not interfere with the operation of the irrigation system.

Additional Criteria For Enhancing Aesthetics

Use evergreen species and species with features such as showy flowers, brilliant fall foliage, persistent colorful fruits or noteworthy growth forms and shapes.

Use a mix of large trees, small trees, and shrubs.

Use curvilinear designs and small group plantings adjacent to interior rows to increase visual sight diversity.

Additional Criteria To Increase Carbon Storage

Select plants that are adapted to the site to assure strong health and vigor and plant the full stocking rate for the site.

Use fast growing species in a mix with long-lived species.

Maintain optimal water and nutrient needs for the planting.

CONSIDERATIONS

Selection of plants for use in windbreaks should favor species or varieties tolerant to herbicides used in the area.

Plants that may be alternate hosts to undesirable pests should be avoided.

Tree or shrub rows should be oriented on or near the contour where water erosion is a concern. Where water erosion and/or runoff from melting snow is a hazard, it should be controlled by supporting practices.

Windbreaks planted across cold air drainages may create frost pockets. Windbreaks that are perpendicular to prevailing summer wind directions may create undesirable areas of hot stagnant air.

Wildlife should be considered when selecting tree or shrub species. Species diversity, including use of native species, should be considered to avoid loss of function due to species-specific pests.

Consideration should be given to adverse offsite effects such as shading and deposit of snow on adjacent areas.

Woody plants established in cropping systems should have root systems that do not affect crop growth and/or spread from root sprouts. Root pruning may eventually be necessary to reduce impacts on adjacent croplands. Refer to WINDBREAK/SHELTERBELT RENOVATION (650) for additional information on root pruning.

Extend the ends of windbreaks at least 200 feet past the area needing protection to account for end effects and to allow for shifts in wind direction.

Species selection that allows for the production of nuts and fruits for human and/or wildlife consumption, wood products, seeds, floral products and other agroforestry products is appropriate where it does not reduce the effectiveness of the windbreak.

Consider using weed barrier/moisture conservation fabric, either in rolls at least 6 feet wide or squares at least 4 feet wide. Heavy grass or weed cover must be destroyed before

fabric installation to prevent rodent damage to plant materials. Use black fabric guaranteed for at least five years. Install on flat, firm ground anchoring with metal staples at least 11 gauge and 6 inches long. Rolled fabric may be anchored by burying edges with 10 to 12 inches of soil. Machines are available for laying rolled fabric very quickly and easily. See reference entitled "Weed Barrier Fabric Mulch..." for more information.

For quick results consider using air-root pruned potted planting stock. This larger material establishes easily and grows rapidly. Balled and burlapped material, by comparison, is often much more expensive and grows slowly for several years after planting. For more information on air-root pruned potted stock see "Container grown" planting stock in practice standard TREE/SHRUB ESTABLISHMENT (612)

PLANS AND SPECIFICATIONS

Specifications for applying this practice shall be prepared for each site and recorded using approved specification sheets, job sheets, technical notes, and narrative statements in the conservation plan, or other acceptable documentation. Minimum documentation will include: Conservation Tree/Shrub Suitability Group, site preparation, species to be planted in each row, spacing within and between rows, planned weed control, maps or drawings needed to show location and site layout.

Recommended species

See CONSERVATION TREE/SHRUB SUITABILITY GROUPS, Section II, Windbreak Interpretations, Field Office Technical Guide for lists of adapted tree and shrub species by soils and 20-year height classes.

Density

Use the row guidelines below to achieve desired barrier densities.

Windbreak densities can be controlled through the type of plants, within row spacing, and the number of rows used. (See How Windbreaks Work in REFERENCES for chart to estimate windbreak densities.)

For specific windbreak row minimums, use the following chart to achieve desired densities.

| Windbreak Type | Minimum # of Rows |
|---------------------------------|-------------------|
| farmstead/shelterbelt | 3ai |
| feedlot | 3ai |
| screens | |
| high traffic | 6c |
| med-low traffic | 3a |
| visual | 2bd |
| wildlife | 5bi |
| field | 1h or 3ei |
| living snow fences | |
| unsheltered distance <1000 feet | 1f |
| unsheltered distance >1000 feet | 2g |
| reducing chemical drift | 1j |

- a = 2 rows must be evergreen
b = 1 row an evergreen species
c = 3 rows must be evergreen
d = 3 rows if all deciduous species are used
e = 2 rows deciduous trees and/or pine species
f = 1 row of shrubs, eastern redcedar or arborvitae
g = at least 1 row e. redcedar or arborvitae
h = must be e. redcedar, arborvitae or spruce spp.
i = 1 row of shrubs
j = tallest tree species adapted to the site

Additional rows may be used to enhance wildlife values, meet landowner objectives, increase diversity, improve natural beauty, and/or increase density.

Additional design specifications for Living Snow Fences

- Use only shrubs and/or cedar species (eastern redcedar or arborvitae).
- Windward rows will be a maximum of 250 feet from the centerline of the roadway or area to be protected.
- Windward rows will not be closer than 80 feet from the shoulder of the roadway or area to be protected.
- The row nearest the roadway or area of protection will be at least 1 ½ times its mature height from the shoulder of the roadway or area to be protected.

An area on the leeward side of a windbreak within 1H to 4H of the windward row will receive maximum snow deposition. Snow will also

accumulate on the windward side for a distance of 1H to 2H. The deepest part of the snowdrift will be closest to dense windbreaks and progressively farther away from the windbreak as windbreak density decreases.

Plant Spacing

Stagger tree spacing so the trees in one row will be planted opposite the opening in the other row.

Example:

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      X      X      X      X
    X      X      X      X      X
      X      X      X      X
  
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Within row spacing:

| | |
|--------------------------------|-------------|
| Small shrubs (< 8' tall) | 3 - 5 feet |
| Shrub/short broadleaf, 8-25' | 5 - 8 feet |
| E. redcedar and arborvitae | 5 - 10 feet |
| Tall deciduous/evergreen trees | 8 - 16 feet |

Between row spacing:

| | |
|--------------------------------|--------------|
| Shrub/short broadleaf (< 25') | 6 - 12 feet |
| E. redcedar and arborvitae | 10 - 16 feet |
| Tall deciduous/evergreen trees | 12 - 20 feet |

Using the closest within row spacing will give quicker results due to canopy closure but may necessitate thinning to maintain full crowns and prevent natural pruning of lower branches. Using the widest spacing will reduce or eliminate the need for maintenance or renovation, especially thinning, but will greatly increase the time for crowns to close and the windbreak to reach maximum effectiveness.

Between row spacing should be at least 4 feet wider than any equipment planned for between-row maintenance.

Use the widest between row spacing if deciduous/evergreen trees are to be planted in adjacent rows of the same windbreak. This will prevent faster growing deciduous species from overtopping conifer species.

Use close within row spacing for windward rows and 2-row windbreaks. Wider spacing is best in middle and lee rows of multi-row windbreaks because plants will develop fuller crowns and require less maintenance.

If trees and/or shrubs are to be established by direct seeding seed at a rate of approximately one seed for every 1.5 to 2 feet of row length. Plan to thin, reserving the best seedlings, to desired final spacing. Refer to practice standard TREE/SHRUB ESTABLISHMENT (612)

Twin Row High Density: A windbreak design consisting of 2 closely spaced offset rows of trees or shrubs that grow together into a single thick row of vegetation. Future windbreak renovation is made easier by wide between row spacing. Close within row spacing minimizes space occupied by trees and shrubs.

- Each twin row set will contain the same species.
- The windbreak will contain a minimum of two twin rows (4 rows total). To promote diversity each twin row set will be composed of a different species of tree or shrub.
- The spacing between twin rows will be 25 to 50 feet to achieve desired objectives.
- For plant spacing within twin rows, use the closest within row spacings listed above. Use the same spacing between rows and between plants within the twin row set.

Site Preparation

Competing vegetation will be controlled by one or more of the following methods:

Fall site preparation prior to spring planting is preferred. A fall temporary seeding may be used where needed to control soil erosion, see practice standard CONSERVATION COVER (327).

If the existing cover is sod, alfalfa, or weedy cropland, control competing vegetation by:

- Strip tilling
- Strip chemical treatment
- Chemical or mechanical spot treatments

If cover is nonweedy cropland:

- Plant in stubble without prior preparation; or
- Lightly disk the area to evenly distribute crop residues.

All spot or strip treatments shall be at least 4 feet in diameter or width.

All chemicals will be used in accordance with label guidelines. If chemicals are handled or applied improperly or if unused portions are not disposed of safely, they may be injurious to humans, domestic animals, desirable plants, and fish or wildlife.

Planting

Refer to practice standard TREE/SHRUB ESTABLISHMENT (612) for planting guidelines.

OPERATION AND MAINTENANCE

The following actions shall be carried out to insure that this practice functions as intended throughout its expected life. These actions include normal repetitive activities in the application and use of the practice (operation), and repair and upkeep of the practice (maintenance):

A weed-free area at least 2 feet in all directions from planted or seeded trees and/or shrubs will be maintained for at least the first 2 years after planting. Competing grass species will continue to be controlled in a 2-foot radius until woody plants are at least equal in height to competing grasses. Noxious weeds will be controlled. If mulches are to be used refer to practice standard MULCHES (484). If herbicides are to be applied read and follow all label directions.

Replacement of dead trees or shrubs will be continued until the windbreak/shelterbelt is functional. Replace any dead plants for the first 2 years. After 2 years at least 85% of plants will be healthy with no two adjacent plants missing.

Supplemental water or weed barrier fabric will be provided as needed.

Thin and/or prune the windbreak to maintain its function.

Inspect trees and shrubs periodically and protect from adverse impacts including insects, diseases, competing vegetation, fire and damage from livestock and wildlife. Tree

shelters may be necessary to protect trees and shrubs from damage by rabbits and/or deer.

Protect windbreaks from herbicides, especially during burndown treatments on adjacent croplands. Use directed sprays around trees and develop a drift control strategy around windbreaks.

Windbreaks may be root pruned if woody plant roots are expected to compete for moisture with adjacent cropping systems. Refer to WINDBREAK/SHELTERBELT RENOVATION (650) for additional information on root pruning.

Properly maintained windbreaks will not require renovation for many years. Maintenance should begin after trees are well established and before crowding starts. This is usually between the tenth and fifteenth year depending on the species, rate of growth and spacing. Periodic removal of individual trees will relieve overcrowding and eliminate the need for major renovation. Care must be taken in removing trees in a windbreak to avoid reducing its effectiveness. See WINDBREAK/SHELTERBELT RENOVATION (650) and reference entitled "Windbreak Management" for more information.

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